

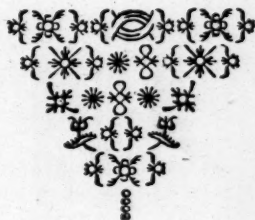
EXPERIMENTS

ON THE

Diffillation of Acids, Volatile Alkalies, &c.

IN A LETTER FROM

Mr. PETER WOULFE, F.R.S. to JOHNELLIS,
Esquire, F. R. S.



L O N D O N,

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EXPERIMENT

ON THE

RELATION OF THE VOLUNTARY AND INVOLUNTARY

IN A CERTAIN CASE

BY JAMES W. WATSON, M.D.

THE following is a summary of the results of the experiments conducted by the author, and is intended to be a general statement of the facts, and not a detailed account of the experiments. The experiments were conducted in the laboratory of the author, and the results were as follows:—

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S I R,

IN the common manner of distillation there escapes a great quantity of fumes, which cannot be condensed; and in several operations these fumes are very hurtful to the lungs. By the following method of distillation these fumes are totally condensed, which makes a great saving in some distillations, and the operator is in no danger of being hurt by any pernicious vapours.

This new method consists in making the fumes pass by a small glass tube through water, which hereby becomes charged with the vapours, that would otherwise escape.

Description of the apparatus, TAB. I.

Fig. 1.

A a retort.

B a receiver, with a spout at bottom, for the distilling liquor to run into the bottle C; the recipient has also a small opening on one side at D.

E a crooked tube $\frac{1}{10}$ and $\frac{1}{2}$ of an inch bore.

F a vessel containing water.

The crooked tube E is fitted to the spout D of the receiver by means of a cork with a hole in its middle, and then well covered with lute; the other end of it goes to the bottom of the vessel F, to the mouth of which it is fitted by a cork, with a semicircular notch in it as at G, but without any lute to fasten it, as there must be a small vent for the escape of the elastic air, and this is the only vent in all the apparatus for that purpose. By this apparatus the fumes are obliged to pass through the water in F, and there deposit all they contain, except their elastic air.

In most distillations there is a quantity of air absorbed at different times during the process; and in this case the external air would press on the water at F, and force it by the tube into the vessel C, which might spoil the distilled liquor. This may be prevented by letting air into the receiver or bottle C, by boring a hole through the lute; this however may be inconvenient, on account of the constant attendance which is necessary; but the following apparatus will prevent it. See figure 2. It consists

consists in fitting an empty vessel H, to the apparatus described before, See figure 1. By this means the water is forced into H, and by the stopper at L it may be emptied, and put back into the vessel F, the crooked tubes D and I are fitted to H, by a cork with two opposite semicircular notches as at K, and then well covered with lute.

EXPERIMENT I.

On the distillation of sal ammoniac with quick lime.

12 lb * of British sal ammoniac, and 26 lb of quick lime were powdered, mixed, and put into the iron body A (fig. 3.); and when the apparatus † was luted, a gallon of water was poured on it through the orifice (b), which was immediately stopped; the lime growing hot produced a vast quantity of elastic air, which though highly charged with volatile alkaly was condensed by the water in F, fig. 2. the air only escaping at the top of this vessel with hardly any sensible volatile alkaline smell. Next morning, all being cold, another gallon of water was added as before, and a very slow fire made under the body for 14 hours, in which time there distilled near a pound of volatile alkaly; the fire was then made stronger, and continued in that state for twelve hours more, in which time there was obtained, together with what was first distilled, 8 lb $\frac{1}{4}$ of volatile alkaly, strong and fit for Eau de luce; this was taken out of the bottle and set apart. The vessels being cool,

* In all the experiments averdupois weight was made use of.

† The spout of the stone head belonging to the body A, figure 3, is to be luted to the receiver B, figure 2.

two gallons more of water were put into the body, and the fire made as before, and continued till there was 7 lb distilled of weak volatile spirit; this answers better than water for a fresh distillation of sal ammoniac and lime.

During the first 16 hours of the distillation, there continually escaped through the water of F elastic air very slightly charged with volatile alkaly, especially when the water grew hot; but during the remaining time of the distillation, no elastic air was set free.

Two stone gallon bottles, with three quarts of water in each, were made use of to condense the vapours; and when one bottle was grown warm by the fumes, the other was put in its place, while it was a cooling in a vessel of cold water; and so continually changed during the whole operation. The six quarts of water encreased by this means 2 lb and $\frac{1}{2}$ in weight; and, by the following experiments it appears, that a pound of this vapour condensed in the water is to a pound of the volatile alkaly, which was set apart for Eau de luce, as 140 to 76, which is nearly twice as strong; therefore there was a saving of near 1 lb of volatile alkaly, which would have been lost in the common manner of distillation.

The water of the two stone bottles charged with alkaline vapours was mixed, in order to reduce them to the same degree of strength, and as much of it was put into a glass cucurbit as contained four ounces of the alkaline vapour; four ounces of the volatile alkaly, which was set apart for Eau de luce was put into another cucurbit of the same size, and

and diluted with water to the same volume of the other.

This last took 1 lb 3 $\frac{3}{4}$ of acid of vitriol, diluted with water, to be saturated, and did not grow hot; whereas the water containing the four ounces of alkaline vapours took up 2 lb 3 $\frac{3}{4}$ of the same acid of vitriol, and grew so very hot, that the vessel could scarce be held in the hand, even after having been diluted at different times with two quarts of water. This shews that there is a great difference in the two, and that it is not intirely owing to strength.

The heat produced by the vapours passing through the water, was tried at another distillation, and raised the quicksilver in Fahrenheit's thermometer to 110 degrees.

In rectifying caustic volatile alkaly with lime, there is likewise a very great quantity of elastic air set free, highly charged with volatile alkaly, which condenses in water and heats it.

Water may be so strongly charged with this vapour, that it will make very strong Eau de luce, nay, much stronger than that which we said before was distilled and set apart for Eau de luce: but it is necessary, as mentioned before, to make use of two stone bottles, changing them as often as they grow warm.

EXPERIMENT II.

On the distillation of the acid of salt by means of the acid of vitriol; for the apparatus see fig. 2.

* A green quart retort coated with loam was made use of for this experiment, and it was placed

* What goes by the name of a quart retort holds better than two gallons of water.

in

in a reverberatory furnace on a naked fire; 14 lb of common salt was put into it, and on that the like quantity of oil of vitriol, which had been diluted the day before with 7 lb of water; the retort was then immediately luted to the recipient, and the distillation conducted in the common manner: the operation continued 16 hours, when hardly any more liquor would come over with a strong fire.

To condense the vapours, two stone gallon bottles with three quarts of water in each were made use of, as in the former experiment.

In this operation there was obtained 9 lb 5 $\frac{3}{4}$ and $\frac{1}{2}$ of spirit of salt, which dropped into the bottle C; the six quarts of water in the stone bottles increased in weight 6 lb 12 $\frac{3}{4}$ and $\frac{1}{2}$; the caput mortuum weight 18 lb 0 $\frac{3}{4}$; so that in this operation there was only a loss of eight ounces, which is but $\frac{1}{70}$ part of the whole, which probably was mostly elastic air.

EXPERIMENT III.

The same operation was repeated with a slower fire, which continued for 23 hours, after which time hardly any more liquor would come over with a strong fire.

There were here produced 11 lb 10 $\frac{3}{4}$ of spirit of salt, in the bottle C; the six quarts of water increased in weight 3 lb 10 $\frac{3}{4}$, and the caput mortuum weighed 19 lb 4 $\frac{3}{4}$; the loss was the same as in the foregoing experiment.

In order to know the different degrees of strength of the acids produced in these two experiments, they

they were saturated with a fixed alkaly dissolved in water.

Four ounces of the acid in experiment II, which distilled into C, took of the alkaline liquor to be saturated $13\frac{2}{3} 5\frac{2}{3} 2\frac{1}{3}$.

As much of the water * in experiment II, as contained $4\frac{2}{3}$ of vapour took to be saturated $1\text{ lb } 9\frac{2}{3}$.

Four ounces of the acid in experiment III, which dropped into C, took of the same alkaline liquor to be saturated $12\frac{2}{3} \frac{1}{2}$.

As much of the water of experiment III, as contained four ounces of vapour † took to be saturated $2\text{ lb } 6\frac{2}{3}$.

Four ounces of oil of vitriol, which was to water in weight as 24 to 13, took of the same alkaline liquor to saturate it $1\text{ lb } 10\frac{2}{3} 7\frac{2}{3}$, which shews that oil of vitriol is not so strong an acid as the vapour of spirit of salt, when condensed in water and distilled slowly, as in experiment III.

From the foregoing experiments it appears, that 1 lb of the spirit of salt vapour, condensed in the water in experiment II, is to 1 lb of the acid of salt, which dropped into C of the same experiment, as 200 is to 109, which is near double; and therefore the $6\text{ lb } 12\frac{2}{3}$ and $\frac{1}{2}$ of the vapour, which condensed in the water, is equal very nearly to $13\text{ lb } 1\frac{2}{3}$ of the acid which is distilled in C: so that by this method of distillation, this great proportion of acid is saved, and those disagreeable suffocating fumes avoided.

* The water of the two bottles was mixed together; for they were of different strength.

† The water of these two bottles were likewise mixed together for the same reason.

In experiment III, 1 lb of the acid vapours, which condensed in the water, is to 1 lb of the acid of salt which dropped into C, as 131 is to 50, or as $2 \frac{31}{50}$ to 1; and therefore the 3 lb 10 $\frac{3}{4}$ of acid vapours, which condensed in the water, is almost equal to 9 lb and $\frac{1}{2}$ of what distilled into C.

It further appears, that the slower the distillation is conducted, the more concentrated are the acid vapours that condense in water. In order to see whether there was any difference in the strength of the acid vapours, which were condensed in the water from the first to the last of the distillation, the following experiments were made.

Five pound of common salt, with 5 lb of oil of vitriol were distilled in a tubulated retort, and three bottles with an equal quantity of water in each were made use of to condense the vapours.

The first bottle increased in weight 3 $\frac{3}{4}$, and during this time, which was twelve hours, there was no fire under the retort; that bottle being taken away, another bottle put under, a fire was made; this bottle increased in weight 1 lb and half an ounce, the third bottle increased 10 $\frac{3}{4}$ and a half.

As much water of each of the three bottles as contained one ounce and a half of the acid fumes was saturated with an alkaly dissolved in water.

The water of the first bottle took
to be saturated

11 $\frac{3}{4}$ $\frac{1}{2}$ a dram.

The second bottle took up

10 $\frac{3}{4}$ 23 20

The third bottle

10 $\frac{3}{4}$ 13

An ounce and half of oil of vitriol, which was to water, as 226 to

118 nearly, took up of the same alkaly 7 $\frac{3}{4}$ 63

[II]

By which it appears that the fumes, which first arose without fire, are stronger than the second, and the second than the third.

It appears further, that the most concentrated portion of the acid of sea salt is the most volatile, and that in strength it is to the oil of vitriol mentioned before, as $44 \frac{1}{4}$ to 31.

* In order to try the purity of the acid vapours, which were condensed in the water, and of the acid, which distilled into the bottle C, the following experiments were made, and are marked a, b, c, d.

(a) Four ounces of the spirit of salt of the 2d experiment, was perfectly saturated with $4 \frac{2}{3}$ of whiting.

(b) Four ounces of the spirit of salt of the 3d experiment, was perfectly saturated with $4 \frac{2}{3}$ of ditto.

(c) As much water as contained $4 \frac{2}{3}$ of vapour of the 2d experiment, was saturated with $5 \frac{2}{3}$ of ditto.

(d) As much water as contained $4 \frac{2}{3}$ of vapour of the 3d experiment, was saturated with $6 \frac{2}{3}$ of ditto.

The reason of using more whiting with some than with others, was on account of the different strength of the acids; and as there was a greater quantity of whiting than necessary used in these experiments to saturate the acids, the undissolved

* This depends on the property of the acid of vitriol, and the acid of sea salt, combined with a calcareous earth; for this earth, combined with the acid of sea salt, forms a very soluble substance; whereas the same earth, with the acid of vitriol, forms a substance insoluble (or almost so), called selenite.

part must consist of whiting; and, if any acid of vitriol in the acids, of whiting and selenite.

In order to separate the selenite from the whiting, a large portion of distilled vinegar was made use of, which dissolves the whiting, it being a calcareous earth; and in order to promote the solution, heat was made use of.

The undissolved part of (a) being perfectly saturated with a sufficient quantity of distilled vinegar, and afterwards repeatedly washed with pure water, and dried, weighed $\frac{1}{2}$ oz. and 26 gr.

(b) treated as (a) weighed $\frac{1}{2}$ oz. and 52 gr.

(c) treated as (a) weighed 39 gr.

(d) treated as (a) weighed 42 gr.

* One ounce of whiting treated as (a) left 7 gr.

From these experiments it appears, that the

Four ounces of acid marked (a) contain as much acid of vitriol as will make

$\frac{1}{2}$ an oz. less 2 gr. of selenite.

Four ounces of acid marked (b)

$\frac{1}{2}$ an oz. and 24 gr. of ditto.

Four ounces of the acid vapour marked (c)

4 gr. of ditto.

Four ounces of the acid vapour marked (d) none.

Hence it is evident, that the vapour of the acid of salt condensed in water, when distilled slow, contains no acid of vitriol; and that even when it is distilled quick, it contains so small a quantity as is not worth notice.

* As whiting contains some parts which are not soluble in distilled vinegar, it was necessary to know how much of this an ounce contained, which must be deducted in proportion to the quantity used for the experiments a, b, c, and d.

If 10 $\frac{3}{4}$ of sea salt are distilled in the common manner with an equal quantity of oil of vitriol unmixed with water, there only distil 2 $\frac{3}{4}$ of spirit of salt; whereas, if distilled in this new manner, we not only obtain the like quantity, but likewise 4 $\frac{3}{4}$ and $\frac{1}{2}$ half more, which are condensed in the water; so that, in making this concentrated spirit of sea salt, there is a saving of above double the quantity, which would be lost in the common method of operating.

Of the heat produced by the vapours of spirit of salt passing through water, spirits of wine, and oil of turpentine:

Three quarts of water were put into a gallon stone bottle, and made use of to condense the vapours, as in experiment the 2d, fig. F; in three hours and a half after the fire was made under the retort, the water in the stone bottle had acquired the degree of 212, which is the mark of boiling water in Fahrenheit's thermometer; and at this time there was scarcely 2 $\frac{3}{4}$ of spirit of salt distilled into the bottle, fig. C. The receiver and bottle C seemed cold to the touch; the water at F had increased 2 lb 3 $\frac{3}{4}$. Another like bottle with the same quantity of water being put in the room of this, in some time, acquired the same degree of heat. The fumes seem to condense very well until the water acquired a heat within twelve degrees of boiling water.

Spirit of wine rectified, made use of instead of water to condense the vapours, acquires a heat equal to 188 degrees; and it grows of a deep brown colour, though transparent.

Oil

5 — Oil of turpentine applied to the same use acquires a heat of 12 degrees above that of boiling water, or 224 degrees; it becomes of a dark brown colour, though transparent, and has a disagreeable bituminous smell. The thermometer not measuring more than ~~213~~ degrees, could not be left in with safety any longer.

Another time oil of turpentine was made use of to condense the vapours, which proceeded from 1 lb $\frac{1}{2}$ of sal ammoniac, with 1 lb $\frac{1}{2}$ of oil of vitriol, and $\frac{3}{4}$ of a pound of water: here it did not grow near so hot, nor so high coloured, as in the other experiment, but was for the most part congealed.

The difference of these two experiments may, perhaps, be owing to the smallness of the quantity of the ingredients in the last process; for in the first there was 14 lb of salt, 14 lb of oil of vitriol, and 7 lb of water.

Of the re-absorbtion of Air in Distillations.

In all distillations a quantity of elastic air is set free in the beginning, but afterwards there is a re-absorbtion of the same; the following experiment was made to shew how great it is in some cases.

For the apparatus, see fig. 1.

One pound and a half of foreign sal ammoniac was put into a retort, and 1 lb $\frac{1}{2}$ of oil of vitriol (previously diluted the day before with $\frac{3}{4}$ of a pound of water) poured on it, and a recipient well luted to it; the recipient had a tube 31 inches, well fitted and luted to it; and this tube was immersed in a glass vessel containing a quart of water.

The spirit of salt which was distilled,	lb	3	3
weighed		2	5
The quart of water increased in weight		5	4
The caput mortuum weigh'd		2	3
The loss in the operation was only			3
		3	12

The operation was continued till the sal ammoniac began to sublime.

When no more air escaped, which might easily be perceived by its ceasing to bubble through the water, the vessel of water was taken away, and the tube was immersed in a basin of quicksilver; the mercury rose in the tube 23 inches and a half, whilst the recipient was too hot to bear one's hand on it longer than half a minute; when the recipient was quite cold, the mercury rose to 29 inches and $\frac{7}{16}$, and there was near one inch of spirit of salt on its surface. This experiment was tried the 11th of November, when the barometer was at 30 inches. In order to make this experiment succeed, it is of the utmost consequence to lute well the vessels.

On the Marine Æther.

The Marquis De Courtenveau, of the Royal Academy of Sciences of Paris, has published a very curious memoir in their Transactions, on the making of Marine Æther, by distilling spirit of wine with the * liquor fumans of Libavius; but no one, that I know of, has succeeded in making it with the pure spirit of salt. It was natural to conclude

* The liquor fumans is made by distilling mercury sublimate with tin, and is composed of the acid of salt united with tin.
from

from the extreme great acidity of the fumes of spirit of salt, that *Æther* might be made by saturating rectified spirits of wine with them; and on trial I found it answer, though not in a large quantity.

The spirit of wine, charged with the acid vapours, must be distilled and cohabated, and then rectified with a slow degree of fire *.

The method that Monsr. Beaumé of Paris proposed to make this *Æther*, and which did not succeed with him on account of his not being able to condense the fumes, answered well with me; and it consists of combining the vapours of spirit of salt with those of spirit of wine. The apparatus that I made use of for this purpose is described at fig. 4, and the process is as follows:

Eight pound of sea salt was put into the retort B, and two quarts of rectified spirit of wine into the retort D; three pints of the same spirits of wine were put into each of the glass vessels I and K, in order to condense the fumes, one not being sufficient; all being well luted and secured, the spirits of wine in D were made to boil, and then 7^{lb} of oil of vitriol was poured on the salt in the retort B, at ten or twelve different times, seven minutes between each time, lest the mixture should boil over; then a fire was made under this retort, and both fires kept up till the operation was over. The quantity of liquor in the vessels I and K, increases considerably from the vapours that condense therein; and the vessel I in particular grows very hot, and being

* As I have shewn before, that the vapours of the acid of salt, which condense in water, are free from the acid of vitriol, we may be certain, that the acid of vitriol did not contribute to form this *Æther*.

highly charged with vapour is rendered incapable of condensing any more; the vapours then pass on to the vessel K, and heat that also.

The liquor then that was distilled into the vessel F, was mixed with the liquor of the vessels I and K, then being * distilled, cohobated and rectified slowly with slacked lime, produced a very subtle penetrating Æther; it is very remarkable, that this, though free from acid, upon mixing it with water, caused a violent ebullition.

An expeditious method of making Nitrous Æther by Distillation, without Fire.

(See fig. 5.) Pour six ounces of the most concentrated spirit of nitre, little by little, on eight ounces of rectified spirit of wine, shaking the vessel each time in which the mixture is made.

Then convey it by a long funnel through the opening of the head at C, into the matrafs A; the opening is afterwards secured by a glass stopper; in warm weather this mixture grows hot in five or six minutes, and distills in a stream into the vessel E, and is over in about half an hour. Before the matrafs grows cold, a fresh mixture is put in as above, and so on for five or six times, till there is liquor enough distilled. This liquor being slowly rectified

* Spirits of wine was used likewise here to condense the vapours; and though the distillation was conducted with a very slow fire, yet the spirits of wine grew very hot. Spirit of wine was likewise used to condense the vapours in the cohobation, but they did not grow hot.

This liquor without cohobation affords Æther, but not so great a quantity.

C

with

with slacked lime, makes very fine *Æther*. The spirit of wine, which was put into the vessels E and F to condense the vapours, is so highly charged with *Æther*, that it will separate on washing with water. This spirit of wine is also an exceeding rich *spiritus nitri dulcis*.

What remains in the matrafs contains a quantity of spirits of wine, which may be separated by distillation.

On the Distillation of the Nitrous Acid, see fig. 2.

The quantity that is condensed in water during the distillation of this acid spirit is so small, that it would be scarce worth saving, if it was not to prevent those noxious fumes, which have such an effect on the lungs of the operator, as frequently to make him spit blood.

Water highly charged with these fumes by repeated distillations becomes blue, and retains its colour*.

I once distilled, in an iron body with a stone head, 30 lb of nitre, with 60 lb of green vitriol, which I had calcined to whiteness, and was obliged to make use of two vessels of water, as in fig. 5, at F and G, to condense the vapours: this water became

* Oil of vitriol was used in this operation, to set free the acid of nitre; and I found upon trial the fumes condensed in the water to be a pure spirit of nitre: whereas, in the other operation, where calcined vitriol or copperas was used, the fumes contained some acid of salt. This led me to try the common green copperas, and I found it contained a portion of iron united to the acid of salt: whereas the Dantzick copperas or vitriol contains no acid of salt, and therefore is fitter to make an aqua fortis for the refiners use.

blue

blue in one distillation, and continued so for 18 months, till I made use of it.

A great quantity of air was set free from the beginning to the end of the distillation, owing in a great measure to the acid fumes acting on the iron body; for if distilled in a glass or stone vessel, the quantity of air is not near so considerable.

The nitrous fumes condensed in water, in making the spiritus nitri fortis appear to be more acid than the strongest oil of vitriol made use of for the experiments on spirit of salt.

Water is not heated by these fumes, owing probably to the smallness of the quantity which condenses therein.

A further application of this new method of Distillation.

In the distillation of the oil of vitriol, a great part of the acid comes over sulphureous, and is very hard to condense; but, by passing it through water, this condensation is easily obtained: however, a greater quantity of water is necessary for this operation than for the spirit of salt, though the water becomes but slightly acid, yet it is greatly sulphureous, and at the same time acquires no heat.

The sulphureous acid obtained by other means, as by distilling the acid of vitriol with mercury, and other substances, is likewise condensable.

Further, this sulphureous acid of vitriol may, by two or three slow rectifications, be deprived of its acid; but it will still retain its penetrating sulphureous gas-like smell.

The vapours which arise in the deflagration of nitre, with charcoal, antimony, &c. commonly called Clyffus, are very hard to condense; but, by making them pass through water, their condensation is thoroughly effected. See fig. 6.

In the rectification of Phosphorus, if water is made use of to condense the vapours, it will become as white as virgin wax, and almost as pliable; which seems to be owing to the water, which prevents its burning.

In the distillation and rectification of the Vitriolic Æther, it is of advantage to make use of spirit of wine to condense the vapours, which otherwise might have been dissipated.

Besides these, a great many other things, too tedious to mention, may be condensed in water, or spirit of wine, to a very great advantage.

I cannot conclude, without mentioning that this new method of distillation bids fair to discover the mercurial and colouring earths of Beccher; for by this method we can condense the most volatile parts of all substances, far better than by any other means.

And I must acknowledge that I received the first hint of it from the common apparatus for reviving mercury from cinnabar.

I am, sir,

Your most obedient servant,

Clekenwell,
Nov. 18, 1767.

Peter Woulfe.

To John Ellis, Esq;
in Gray's Inn.

Expla-

Explanation of Plate I.

Figure 1.

- A, A glass retort.
- B, A glass receiver.
- C, A bottle to receive what distils.
- F, A glass, or stone vessel with water.

The recipient B, has a spout at the bottom, which conveys the liquor which distils into the bottle C; at the end there is a spout D.

- E, A crooked glass tube $\frac{1}{16}$ and $\frac{1}{2}$ of an inch bore.
- G, A cork with a semicircular notch to stop the bottle F.

Figure 2.

- A, A glass retort.
- B, A glass receiver.
- C, A bottle to receive the distilled liquor.
- HH, Glass or stone vessels, with glass stoppers, ground and fitted to LL.
- F, A stone bottle with water.
- D, A crooked tube, as at E, fig. 1.
- I, Another crooked tube.
- K, A cork, with two semicircular notches to fit the crooked tubes to the vessel H.

Figure 3.

- A, An iron body with a stone head, which has a stopper at b.
- B, A stand to support the receivers and bottles.

Figure 4.

- A, The furnace, in which is placed the retort B.
- B. A

- B, A glass tubulated retort, which is to be coated with loam up to B.
- C, Another furnace.
- D, A tubulated retort, fixed in a vessel with sand.
- E, A stone vessel, wherein the vapours of B and D are combined together.
- F, A bottle to receive the liquor which distils.
- G, A large tube fitted to E, about $\frac{3}{4}$ inch bore.
- H, A crooked pipe about $\frac{1}{4}$ inch bore.
- I and K, glass vessels containing spirits of wine.
- L, A crooked glass tube.

Plate II.

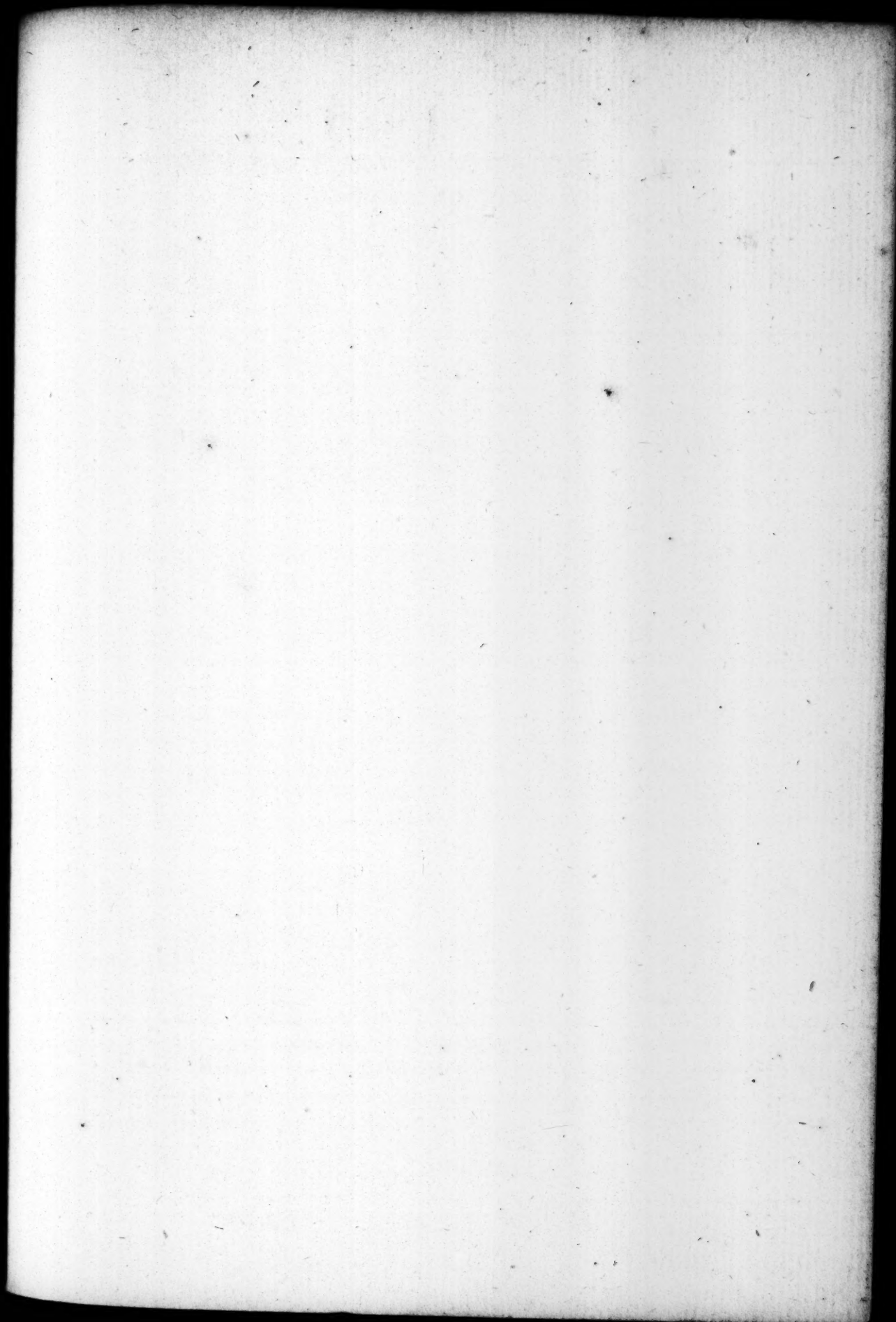
Figure 5.

- A, A glass matrafs about $4\frac{1}{2}$ feet high.
- B, A glass head, with a spout and glass stopper C.
- H, A glass tube.
- P, The receiver.
- E, The bottle to receive the liquor which distils.
- F and G, Glass vessels containing spirits of wine.
- HH, crooked tubes.

Figure 6.

- A, An iron or earthen retort.
- B, The upper part of the retort, with an opening at top, which is to be stopped occasionally.
- CCCC, Crooked stone pipes.
- DDDD, Glass receivers, containing water.
- E, A crooked spout, proceeding from the last receivers, to let out the air that is set free in the operation.

T H E E N D.



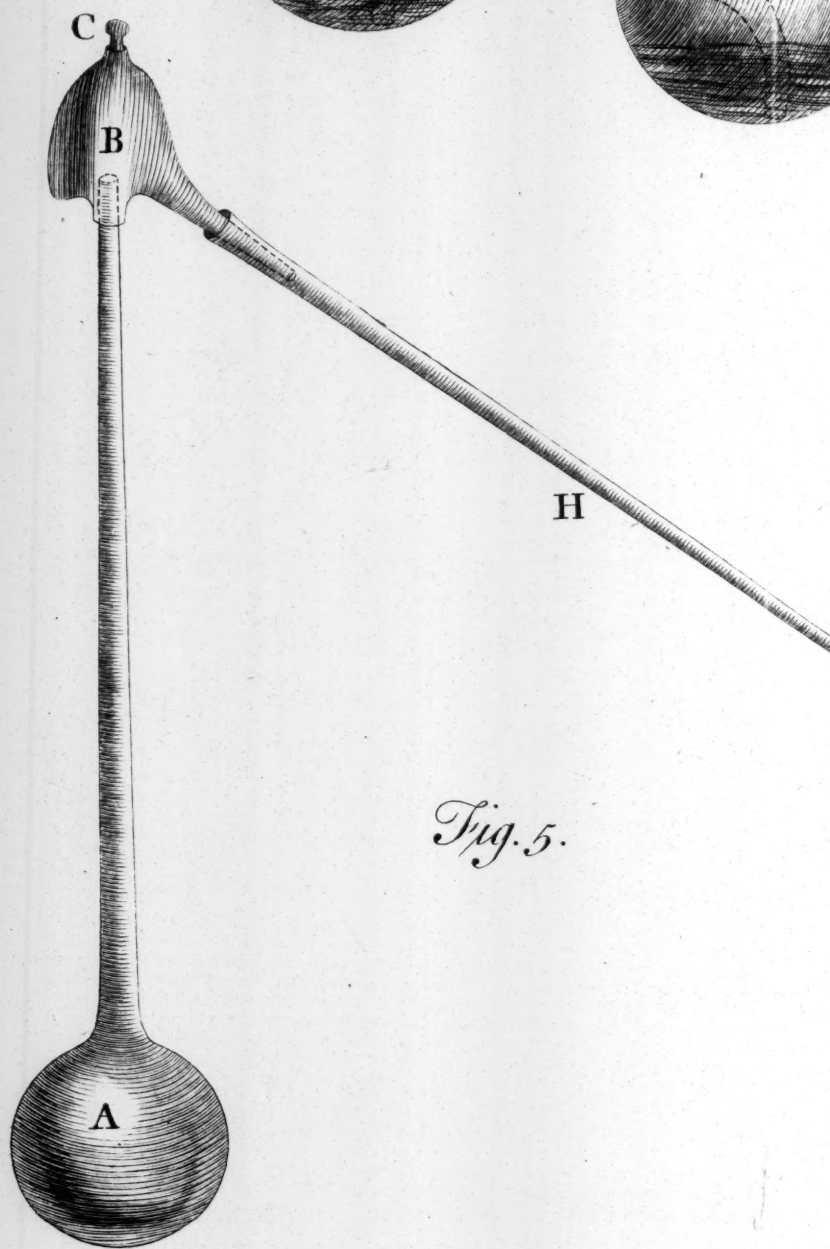
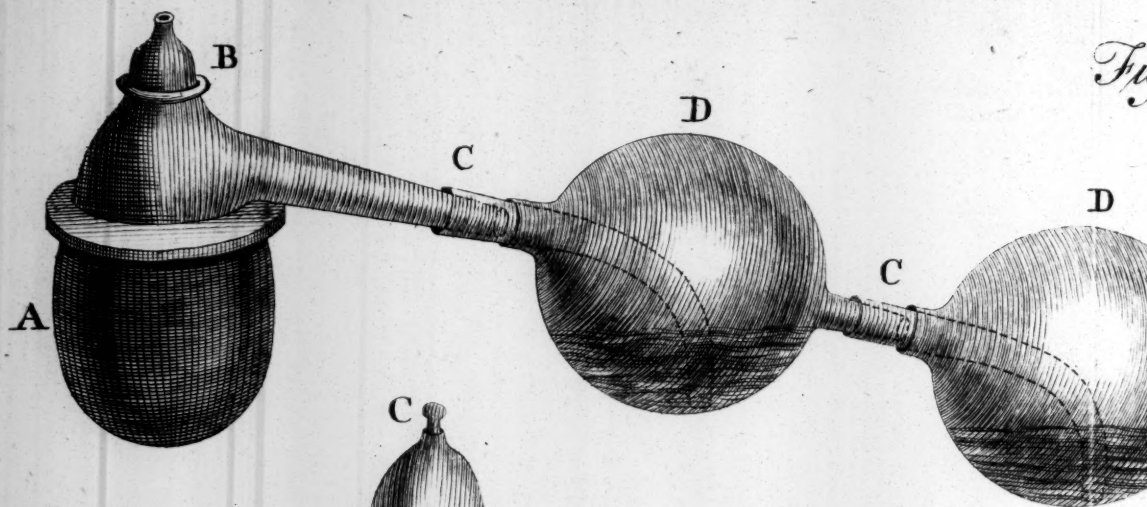


Fig. 5.

Fig. 6.

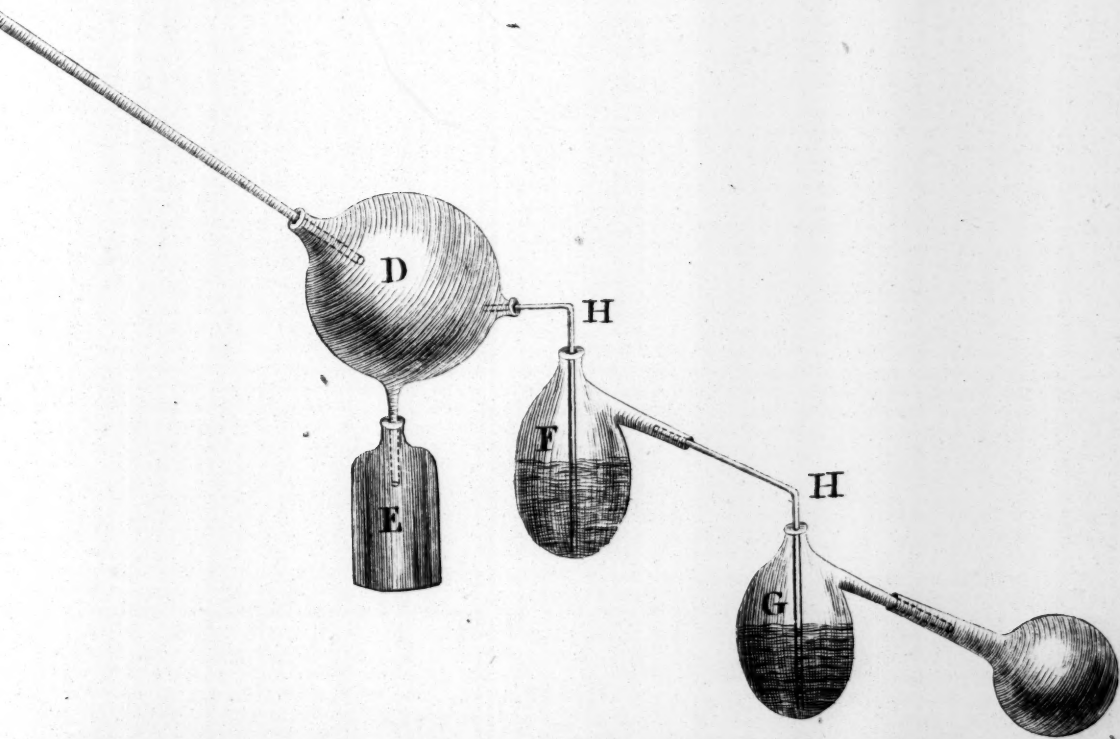
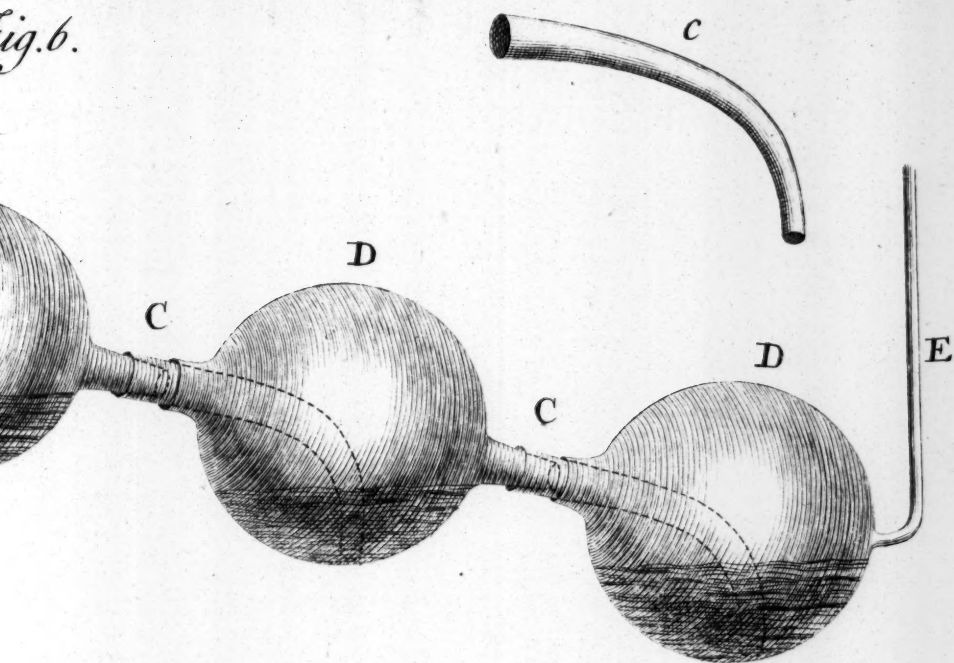


Fig. 1.

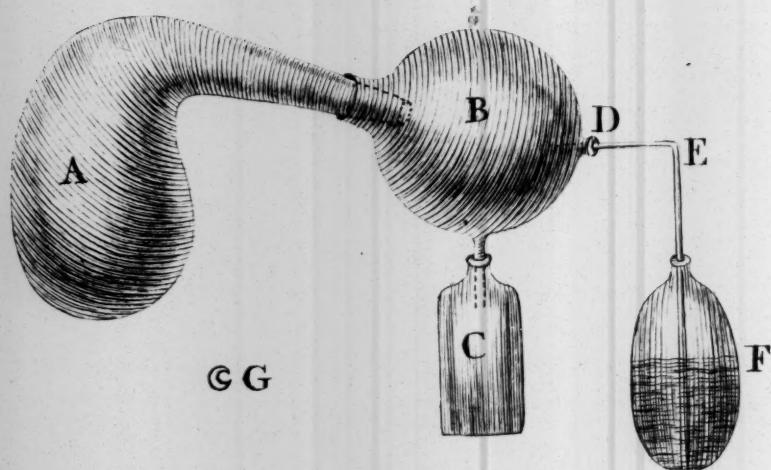


Fig. 2.

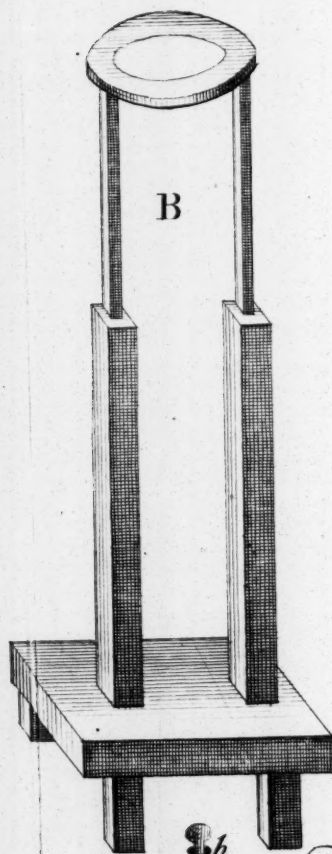
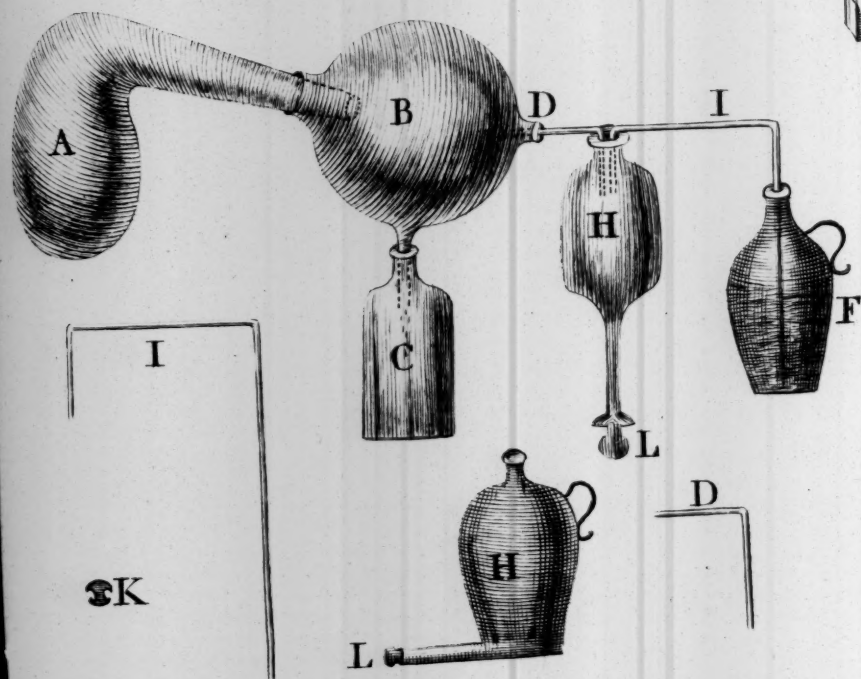


Fig. 3.

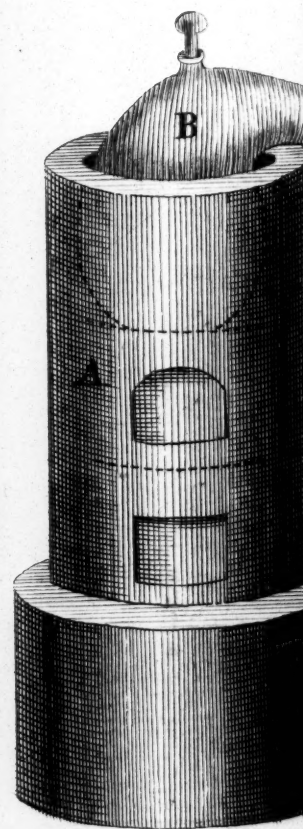
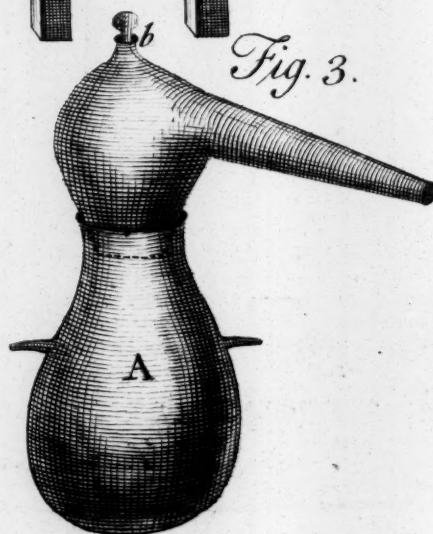


Fig. 4.

